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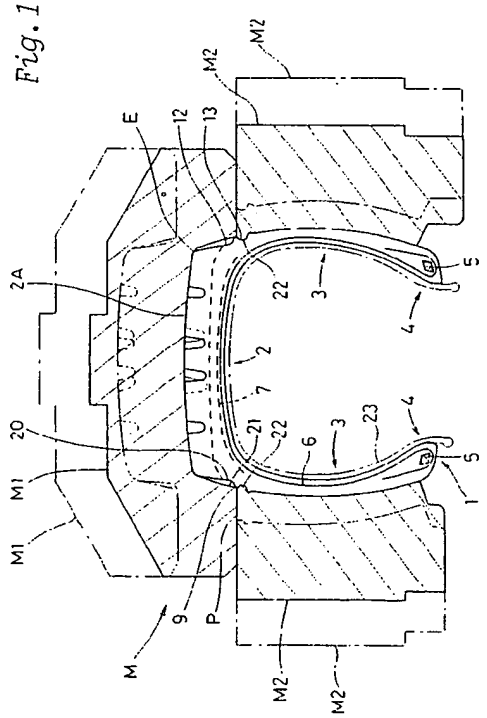
(54) Pneumatic tyre and method of making the same

(57) A pneumatic tyre and a method of making the same are disclosed, wherein the tyre is made by vulcanising a green tyre in a split mould. The mould has circumferentially extending split lines at a position corresponding to the tyre buttress region (11). The inner surface of the mould is provided with protrusions (12) immediately radially outside the split lines and a rib (13) immediately radially inside the split lines, so that the finished vulcanised tyre has depressions and grooves corresponding to the protrusions and rib, respectively. During mould closure in the manufacture of the tyre the raw tyre rubber does not get between the split faces of the mould as the protrusions and ribs (12,13) resist this, and the occurrence of burrs along the mould-split lines can be completely prevented.

Fig. 1



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Description

The present invention relates to a pneumatic tyre and a method of making the same, in which the occurrence of burrs or spues of rubber caused in the buttress portion of the tyre along split lines of the vulcanising mould are prevented.

Generally, pneumatic tyres, particularly those having deep tread patterns for example snow tyres having a block type tread pattern and the like are manufactured by vulcanising a green tyre (raw tyre) in a split mould.

As shown in Figs.5 and 6, such a mould (m) usually comprises sidewall dies (m2) (hereinafter called side-plates) disposed on both sides of a green tyre (t) and tread dies (m1) (hereinafter called sector plates) disposed around the tyre.

When vulcanising a green tyre (t), each side-plate (m2) is moved axially inwardly towards one of the tyre sidewalls and the sector plates (m1) are moved radially inwardly towards the tyre tread as shown in Fig.5 by arrows, and the split faces (p) of the sector plates (m1) and the side-plates (m2) contact with each other to close the space therebetween as shown in Fig.6. Thus, the dies (m1 and m2) collectively form a closed shell structure. Then, a bladder or tube disposed inside the tyre in advance is inflated to a high pressure to thereby pressurise the inside of the tyre to press the tyre outer surface against the negative impression of the mould.

However, at the time of closing the space between the split faces (p) of the sector plates (m1) and side-plates (m2), some tyre raw rubber is liable to get between the split faces (p). As a result, so called burrs (a) are formed on the outer surface of the vulcanised tyre along the split lines of the mould.

Incidentally, small lines corresponding to the split lines of a mould are more or less formed on the outer surface of a vulcanised tyre. Thus, the split lines of the mould is recognisable from such lines on the tyre outer surface (hereinafter mould-split lines).

It is therefore, an object of the present invention to provide a pneumatic tyre and a method of making the same, in which the occurrence of burrs due to tyre rubber being trapped between the split faces of the vulcanising mould can be avoided.

According to one aspect of the present invention, a pneumatic tyre comprises a tread portion and a pair of sidewall portions extending radially inwardly from tread edges, each sidewall portion having in a buttress region of the tyre a circumferentially extending mould-split line impressed by a split line of a split mould, wherein each sidewall portion is provided with a plurality of depressions and a circumferential groove, the depressions are formed radially outside the impressed mould-split line and arranged in a row along and adjacent to the impressed mould-split line, each depression having a depth of 0.5 to 5.0 mm and a maximum circumferential length of 5.0 to 10.0 mm, and the circumferential groove is formed radially inside the impressed mould-split line and extending along and adjacent to the impressed mould-split line, the circumferential groove having a depth of 1.0 to 3.0 mm and a width of from 2 to 10 mm.

Preferably, the total of the maximum circumferential lengths of the depressions is not less than 50 % of the circumferential length measured at the corresponding position.

According to another aspect of the present invention, a method of making a tyre comprises steps of building a green tyre, putting the green tyre in the split mould, closing the split mould, and vulcanising the green tyre in the split mould, wherein the split mould comprises side-plates for moulding the axially outer surface of the tyre sidewall portions and sector plates for moulding the radially outer surface of the tyre tread portion, the side-plates being disposed oppositely each other in the axial direction of the tyre and being movable in the axial direction, the sector plates being disposed radially outside the sidewall plates and being movable in the radial direction of the tyre, such that in the closed state of the mould, the sector plates extend between radially outer edges of the side-plates to define split lines between the radially outer edges of the side-plates and radially inner edges of the sector plates, the inner surfaces of the sector plates being provided adjacent to the split lines with protrusions, the protrusions being arranged circumferentially at intervals, the height of the protrusions gradually increasing radially outwardly from the split lines, and the maximum height thereof being in the range of from 0.5 to 5.0 mm, and the inner surface of each side-plates being provided adjacent to the split line with a circumferentially extending rib, the maximum height of the rib is in the range of from 1.0 to 3.0 mm so that on closing the mould onto a tyre the protrusions and rib push the green tyre from the split lines until the mould is closed.

Therefore, the protrusions of the sector plates for forming the depressions and the ribs of the side-plates for forming the groove push back the green tyre from the split faces when closing the mould. Thus, the tyre raw rubber is prevented from being trapped between the split faces of the mould, and the occurrence of burrs can be effectively prevented.

Embodiments of the present invention will now be explained utilising the attached diagrammatic drawings in which:-

Fig.1 is a cross sectional view of a tyre and a split mould;

Fig.2 is a schematic cross sectional view of the tyre showing the buttress region of the sidewall portion of the tyre;

Fig.3 is a perspective view of the buttress region;

Fig.4 is a cross sectional view showing that the split mould is closed but the tyre raw rubber does not get between the split faces of the mould; and

Figs.5 and 6 are cross sectional views for explaining the conventional art.

In Fig.1, the pneumatic tyre 1 according to the present invention is a block pattern tyre. The tyre comprises a tread portion 2 with a tread surface 2A, a pair of axially spaced bead portions 4, a pair of sidewall portions 3 extending between the tread edges and the bead portions, a carcass 6 extending between the bead portions 4 through the tread portion 2 and sidewall portions 3 and turned up around bead cores 5, and a belt 7 disposed radially outside the carcass 6 and inside the tread portion 2.

The carcass 6 comprises at least one ply, in this embodiment only one ply of cords arranged radially at an angle of from 90 to 75 degrees with respect to the tyre equator. For the carcass cords, organic fibre cords, e.g. polyester, aromatic polyamide, nylon, rayon and the like are used.

The belt 7 comprises two cross plies, each made of parallel cords laid at a small angle of not more than 5 degrees with respect to the tyre equator. For the belt cords, steel cords or organic fibre cords, e.g. aromatic polyamide, nylon, polyester, rayon and the like are used.

The pneumatic tyre 1 is made by vulcanising and moulding a green tyre 1A in a split mould M.

The split mould M comprises side-plates M2 and sector plates M1. When viewed from axially outside the mould, each sidewall plate M2 has an annular shape and each sector plate M1 has a fan shape. The side-plates M2 are disposed oppositely each other so as to face the axially outer surface of the tyre sidewall portions 3. The sector plates M1 are disposed around the radially outside of the sidewall plates M2 so as to face the radially outer surface of the tyre tread portion 2.

The radially inner surface of each sector plates M1 is provided with a negative impression of part of the block pattern. The split line between each of the side-plates and sector plates make a circle, and its corresponding position on the tyre is in the buttress region. The buttress region is the radially outer region of the sidewall portion which is immediately radially inside the tread edge and there buttresses 11 are provided.

The sector plates M1 are supported to be movable in the radial direction and the side-plates M2 are supported to be movable in the axial direction. To close the mould M, the sector plates M1 are moved radially inwardly and the side-plates M2 are moved axially inwardly.

In order to form the buttress region, the inner surface of the sector plate M1 is provided radially adjacent to the split face P with protrusions 20. The protrusions 20 are arranged circumferentially at a regular pitch, forming a space 21 therebetween. Each of the protrusions 20 extends radially outwardly from the edge of the split face P.

As shown in Fig.4, the height of the protrusions 20 increase gradually from the edge of the split face P towards the radially outside thereof and also increases gradually from the position corresponding to the tread edge E towards the radially inside thereof. The maximum height L1 thereof is limited in the range of from 0.5 to 5.0 mm

The maximum circumferential length of the protrusions 20 is in the range of 5.0 to 10.0 mm, which occurs at the radially inner end thereof in this embodiment. The maximum circumferential lengths of the protrusions 20 amount to 50 to 90 % of the overall circumferential length measured at the corresponding position, that is, the radially inner end of the protrusions in this embodiment.

In a cross section including the tyre axis, the profile of the protrusions 20 is smoothly curved by an arc.

On the other hand, the axially inner surface of the side-plate M2 is provided radially adjacent to the split face P with a rib 22. The rib 22 extends continuously in the circumferential direction.

The maximum height L2 of the rib 22 is in the range of from 1.0 to 3.0 mm, and the width L3 is in the range of from 2 to 10 mm.

When the sector plates M1 are moved radially inwardly and the side-plates M2 are moved axially inwardly to close the mould M, the protrusions 20 and rib 22 push back the sidewall rubber of the tyre disposed therein far from the split faces P as shown in Fig.4. Thus, the rubber is prevented from being pinched or trapped between the split faces P before they meet.

Then, on heating the green tyre 1A, the inside of the tyre is pressurised at a high pressure by means of inflation of a bladder 23 disposed therein, whereby the outer surface of the tyre is pressed onto the inner surface of the mould M.

As a result, the block pattern is impressed in the tread portion, and depressions 12 being negative of the protrusions 20 and a circumferential groove 13 being negative of the rib 22 are impressed in the buttress region of the vulcanised tyre as shown in Figs.2 and 3.

Accordingly, the depressions 12 have a maximum depth D1 of 0.5 to 5.0 mm, and a maximum circumferential length LM of 5.0 to 10.0 mm. The maximum circumferential lengths LM of the depressions 12 amount to 50 to 90 % of the total length measured along the circumference passing at the maximum length position. The circumferential groove 13 has a depth D2 of from 1.0 to 3.0 mm and a width W of from 2 to 10 mm.

Further, the buttress 11 are formed between the depressions 12 at a regular interval.

Furthermore, a mould-split line 9 corresponding to the split line or border line between the split faces P is impressed between the depressions 12 and the circumferential groove 13. But, no burr is formed.

Preferably, the mould-split line 9 is positioned radially outside the axial end of the belt 7 because deformation of the green tyre 1A during closing the mould is small in this region which is thus desirable for preventing the rubber from being bitten between the split faces.

If the depth of the depressions 12 of the tyre or the height of the protrusions 20 of the sector plates is less than 0.5 mm, it is difficult to push back the green tyre on

the radially outside of the split line. Thus, burrs are liable to occur. If the depth or height is more than 5.0 mm, a stress concentration is liable to occur around the depressions. Thus, the durability of the tyre decreases.

If the maximum length of the depressions 12 or protrusions 20 is less than 5.0 mm, it is difficult to push back the green tyre on the radially outside of the split line. Thus, burrs are liable to occur. If the maximum length is more than 10.0 mm, the tyre strength decreases in the buttress region.

If the depth of the circumferential grooves 13 of the tyre or the height of the ribs 22 of the side-plates is less than 1.0 mm, as the amount of pushing-back is very small, burrs are liable to occur. If the depth or height is more than 3.0 mm, the profile of the tyre excessively changes at the grooves 13 and a stress concentration is liable to occur.

If the width of the circumferential grooves 13 or the ribs 22 is less than 2 mm, it is difficult to push back the green tyre by the side-plates, and burrs are liable to occur. If the width is more than 10 mm, the tyre strength decreases in the buttress region.

If the total length of the depressions or protrusions is less than 50%, the sector plates can not push back the green tyre the rubber on the radially outside of the split lines is bitten between the split faces and burrs occur. The total length is more preferably set in the range of not more than 90%, thereby effectively preventing the change in the tyre profile line, the concentration of stress and the decrease in the tyre strength.

Incidentally, the above-mentioned height and depth are measured from the profile line of the tyre and mould normally thereto. The width and length are measured along the profile line.

By increasing the height of the depressions or the depth of the protrusions, the effect of the protrusions is further enhanced. Preferably, the maximum heights of the protrusions 20 and ribs 22, that is, the maximum depths of the depressions 12 and grooves 13 occur at a position within 10 mm from the split lines.

As described above, according to the present invention, the occurrence of rubber burrs along the mould-split lines can be completely prevented.

Claims

1. A pneumatic tyre comprising a tread portion (2) and a pair of sidewall portions (3) extending radially inwardly from tread edges (E) , each sidewall portion (3) having in a buttress region (11) of the tyre a circumferentially extending line impressed by a split line (9) of a split mould, characterised in that each sidewall portion (3) is provided with a plurality of depressions (12) and a circumferential groove (13), the depressions (12) being formed radially outside the impressed line and arranged in a row along and adjacent to the impressed line, each depression (12) having a depth of 0.5 to 5.0 mm and a maximum circumferential length of 5.0 to 10.0 mm, and the circumferential groove (13) is formed radially inside the impressed line and extending along and adjacent to the impressed line, the circumferential groove (13) having a depth of 1.0 to 3.0 mm and a width of from 2 to 10 mm.

2. A pneumatic tyre according to claim 1, characterised in that the total of the maximum circumferential lengths of the depressions (12) is not less than 50 % of the circumferential length measured at the corresponding position.

3. A pneumatic tyre according to claim 1 or 2, characterised in that the depressions extend radially outwards, starting from the impressed line.

4. A method of making a pneumatic tyre, characterised in that the method comprises steps of building a green tyre, putting the green tyre in a split mould, closing the split mould, and vulcanising the green tyre in the split mould, characterised in that the mould comprising side-plates (M2) for moulding the axially outer surface of the tyre sidewall portions (3) and sector plates (M1) for moulding the radially outer surface of the tyre tread portion (2), the side-plates (M2) being disposed oppositely each other in the axial direction of the tyre and being movable in the axial direction, the sector plates (M1) being disposed radially outside the sidewall plates (M2) and being movable in the radial direction of the tyre, such that in the closed state of the mould, the sector plates (M1) extend between the radially outer edges of the side-plates (M2) to define split lines between the radially outer edges of the side-plates and radially inner edges of the sector plates (M1), characterised in that the inner surfaces of the sector plates (M1) are provided adjacent to the split lines with protrusions (12), the protrusions (12) being arranged circumferentially at intervals, the height of the protrusions gradually increases radially outwardly from the split lines and the maximum height is in the range of from 0.5 to 5.0 mm, and the inner surface of each side-plates is provided adjacent to the split line with a circumferentially extending rib, the maximum height of the rib being in the range of from 1.0 to 3.0 mm such that on closing the mould on to a tyre the protrusions 12) and rib (13) push the green tyre from the split line until the mould is closed.

Fig. 1

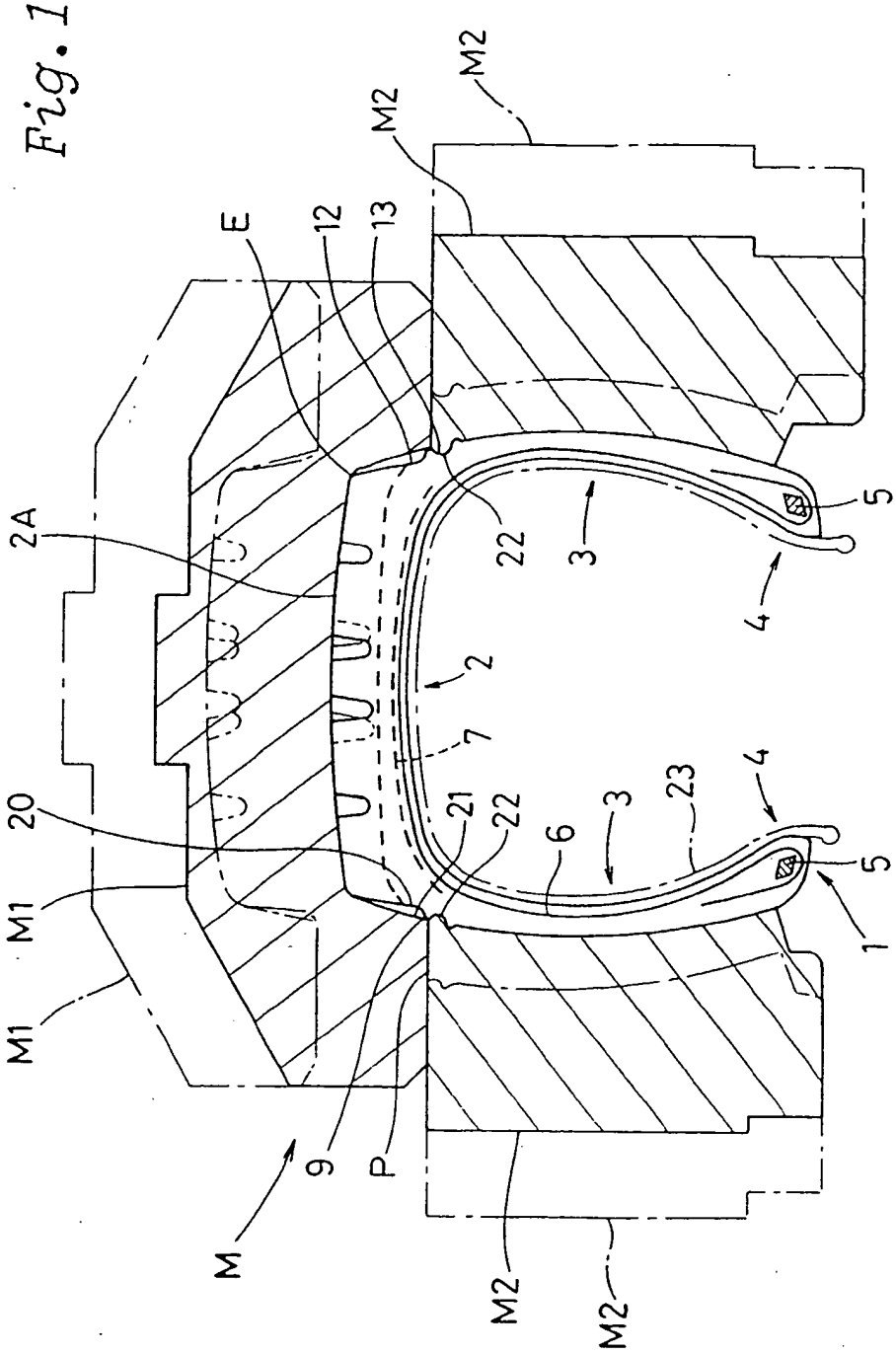


Fig. 2

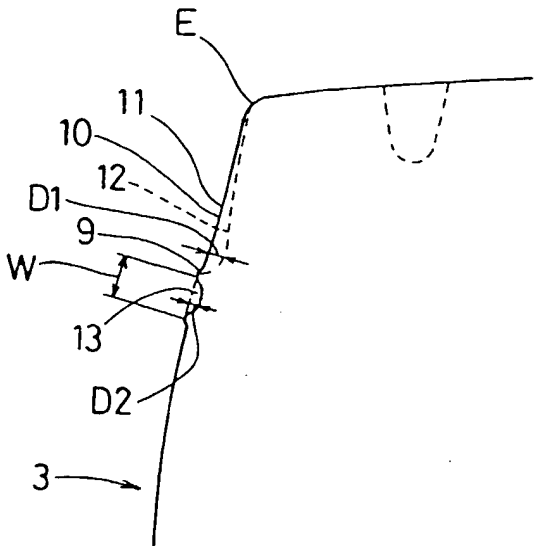


Fig. 3

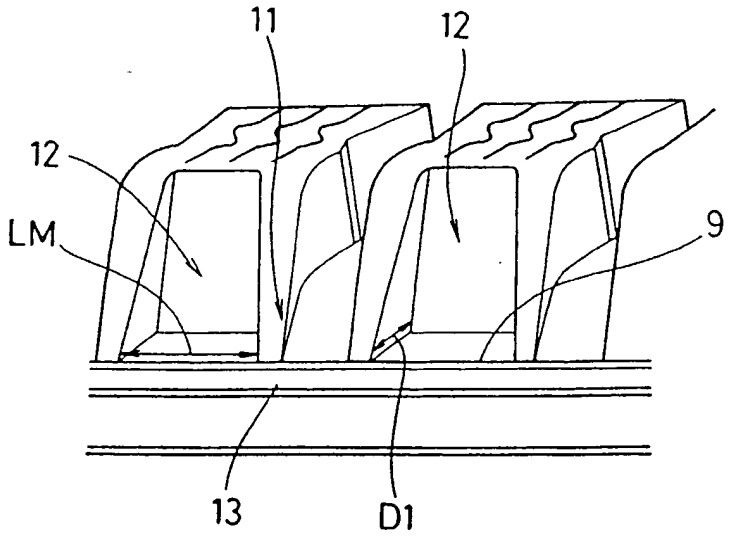


Fig. 4

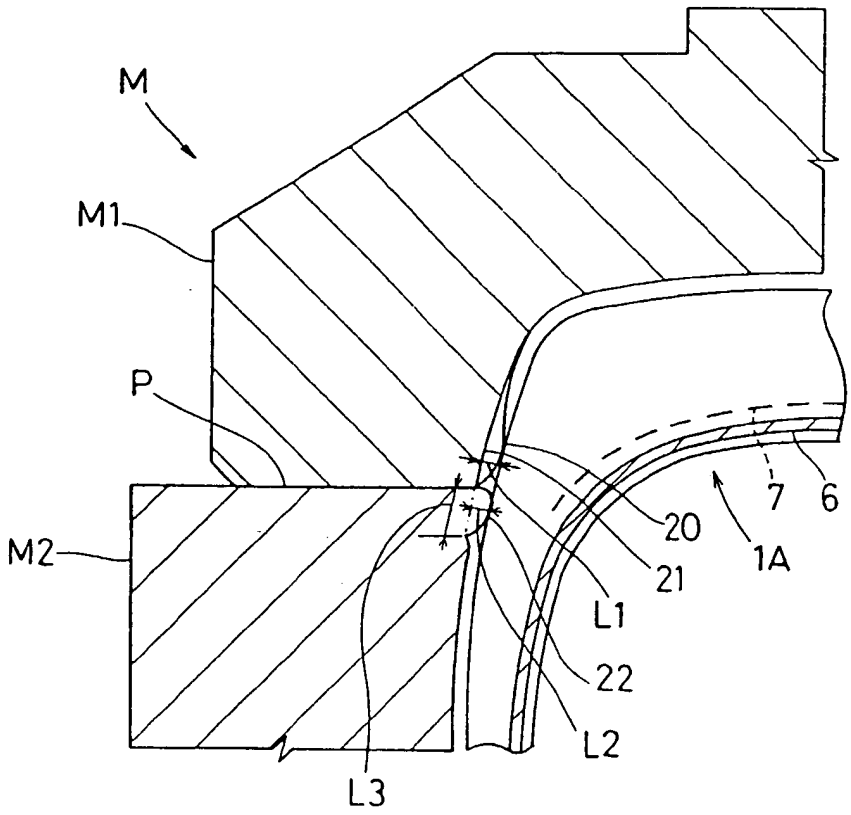


Fig. 5

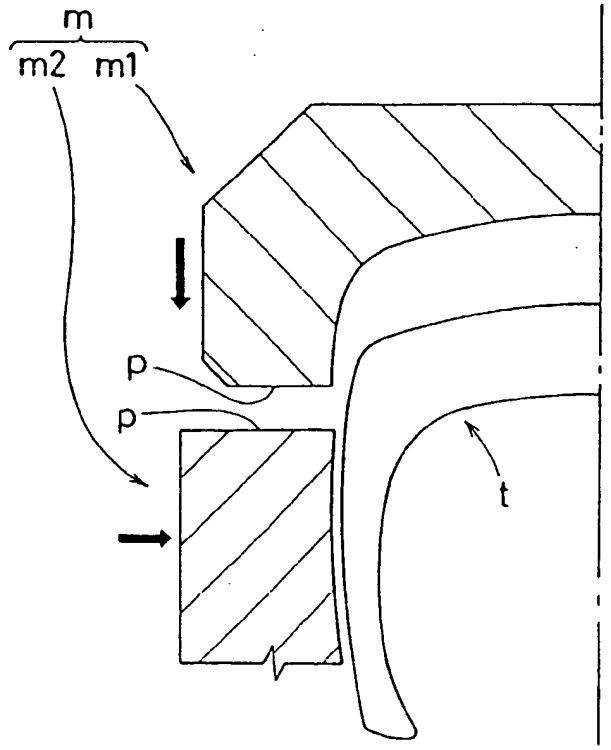
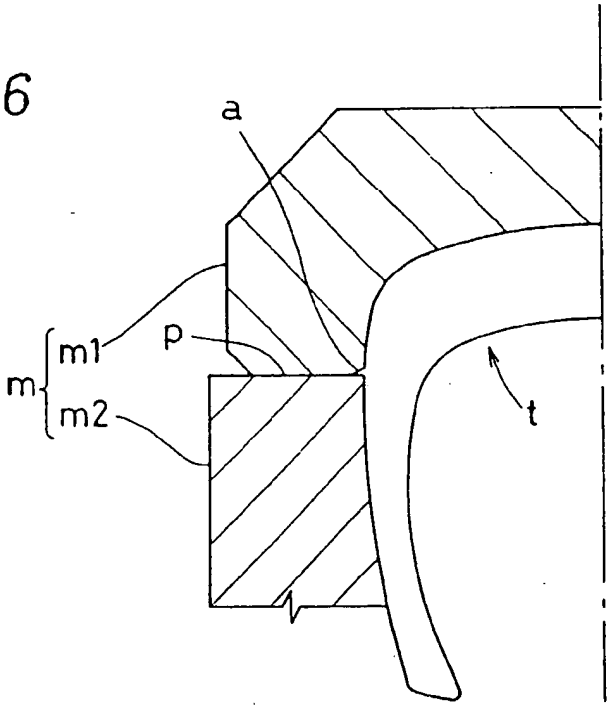


Fig. 6



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EUROPEAN SEARCH REPORT

Application Number EP 96300887.5

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 6)
A	EP - A - 0 320 143 (SUMITOMO RUBBER INDUSTRIES, CO.LTD.) * Abstract; fig. 1,3 * --	1-3	B 60 C 13/02 B 60 C 11/01 B 29 C 33/42 B 29 C 35/02
A	US - A - 5 188 683 (BONKO) * Fig. 4 * --	1	
A	EP - A - 0 229 985 (PIRELLI COORDINAMENTO PNEUMATICI) * Totality * ----	4	
			TECHNICAL FIELDS SEARCHED (Int. Cl. 6)
			B 60 C B 29 C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	13-05-1996	WIDHALM

CATEGORY OF CITED DOCUMENTS

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